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ELECTRONICS AND ELECTRICAL ENGINEERING

No. 66



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AMPLIFIERS

UDC 621.375"71"

OUTLOOK FOR DEVELOPMENT OF D.C. AMPLIFIERS IN MODULAR CONSTRUCTION

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 3, Mar 80 pp 19-20

MELIKHOV, I. B., engineer

[Abstract] The trend toward microminiaturization also affects d.c. amplifiers produced at the "Mikropribor" plant in L'vov. Their three major applications are: 1) Operational amplifiers with negative feedback; 2) High-speed comparators for determining the sign of the difference between two signals; and 3) High-precision instrument amplifiers. The modular construction of these devices is compared with hybrid-film and semiconductor technologies on the basis of product performance, manufacturing cost and product development time. Modular construction is superior with respect to the performance criterion, although high-speed operation and minimization of stray interelectrode capacitances present problems. Its advantages include the feasibility of producing high resistances and the freedom of almost unlimited diversification of components as well as the freedom of their adequate spacing, although a higher degree of diversification results in a lower reliability. In terms of manufacturing cost, modular construction offers an advantage in small-volume production only, and when size is not an overriding factor. Modular construction, furthermore, requires least time for product development. The outlook is best for comparators featuring high speed combined with low drift and input currents. Comparators MK4801-MK4804, as well as operational amplifiers 701ML18 and ML4803, are now series manufactured, while an instrument amplifier ML4805 and an analog memory MD4801 are under development. The overall outlook for modular construction will depend on breakthroughs which will make hitherto unachievable features feasible, but it will only remain good where delicate and intricate devices are involved. Otherwise it will not be as good as the outlook for further circuit integration. References: 2 Western. [206-2415]

ANTENNAS

UDC 621.396.67.012.12

DIRECTIVITY-OPTIMAL PHASE SYNTHESIS OF MULTIBEAM RADIATION PATTERNS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24 No 12, Dec 79 pp 2414-2421 manuscript received 22 Dec 77; after revision 23 Mar 79

KASHIN, V. A. and KUKHTEVICH, A. V.

[Abstract] Multibeam radiation patterns can be synthesized by regulation of the current phases in the array with the aid of phase shifters. Here single-channel synthesis by this method is considered which will result in optimum directivity. The problem is first solved for a plane antenna, assuming that its elements are weakly coupled and their radiation patterns have been orthonormalized. For such an array the distribution is calculated of current phases which will result in formation of a beam with maximum gain in a given direction and all side lobes suppressed. The equation for this is solved with the aid of indeterminate Lagrange multipliers and yields expressions which can be asymptotically evaluated. This method, applicable to linear as well as circular arrays, is now extended to formation of 2-beam and 3-beam radiation patterns with a respective 3.7-3.9 dB and 4.8-5.6 dB loss of directive gain. Figures 6; references: 5 Russian.

[204-2415]

UDC 621.396.67.012.12

OPTIMIZATION OF A SYSTEM OF ORTHOGONAL RADIATION PATTERNS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24 No 12, Dec 79 pp 2422-2430 manuscript received 10 Nov 78

SHKOL'NIKOV, A. M.

[Abstract] A system of finite-dimensional orthogonal radiation patterns is constructed closest, in terms of minimum standard deviation, to a non-orthogonal system with some optimum characteristic. This method utilizes the polar expansion of matrices, its uniqueness property, and the proximity (in the sense of Euclidean norm) of a unitary matrix to a diagonal one. Calculations by this method have been programmed on a BESM-4 computer for use in antenna design and optimization of various criteria such as maximum directivity or decoupling. Possible applications include the design of commutating antenna arrays with the minimum number of elements. Figures 3; references: 11 Russian.

[204-2415]

UDC 621.396.67.012.12:621.396.965

AMPLIPHASOMETRIC METHOD OF ANTENNA MEASUREMENTS (SURVEY)

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24 No 12, Dec 79 pp 2381-2413 manuscript received 21 Nov 78

TURCHIN, V. I. and TSEYTLIN, N. M.

[Abstract] In the ampliphasometric method of antenna measurements one first determines the amplitude-phase distribution in the near field of an antenna and then, from this distribution over some surface, one calculates the radiation pattern throughout the entire space including, specifically, the amplitude-phase distribution over the antenna aperture and at infinity, as well as the energy characteristics of the antenna. The radiation pattern is thus reconstructed from near-field measurements, with the assumption that they have been made at every point of a smooth closed or infinitely large scanning surface, that they yield the tangential component of the electric field, as if the antenna were a dipole oriented tangentially to the scanning surface, and that there are no radiation sources or scattering bodies in the far field. In reality the scanning range is finite and the probing antenna moves rapidly from one position to another. These factors are built into the pro-

A subsequent accuracy evaluation, usually by statistical analysis, includes errors of signal measurements and positional errors of the probing antenna as the main sources of inaccuracy. An alternate method of reconstructing the radiation pattern is synthesis of the aperture on the scanning surface, which takes into account diffraction according to the geometric theory. In the amplitphasometric method measurements can be made in a plane a few wavelengths away from the test antenna and the radiation pattern is then calculated by a Fourier transformation of the data. They can also be made on a cylindrical or spherical surface, with the radiation pattern then reconstructed by expansion into natural modes. They can also be made on a segment of a curving surface within the Fresnel zone, with a subsequent Fresnel integral transformation of the data. The details of the measuring equipment vary accordingly. It essentially consists of the test antenna (receiver), the probing antenna, a coordinator and a linkage mechanism, an oscillator, a 2-channel receiver, and a data control and gathering system. Data are recorded in digital form for processing on a digital computer large or mini, although optical analog processing is also feasible. Most efficient is the algorithm of a fast Fourier transformation, but the other algorithms of reconstructing the radiation pattern have also been programmed and used in practice. Figures 18; tables 1; references 95: 59 Russian, 36 Western (4 in translation).

[204-2415]

AN ANTENNA FOR COMMUNICATIONS THROUGH SATELLITES

Moscow RADIO in Russian Nc 2, Feb 80 pp 16-18

KHARCHENKO, K. and KANAYEV, K., Leningrad

[Abstract] An elliptically polarized five-element beam antenna for working through a radio amateur satellite on 144 MHz is described. The directional gain of the antenna is 11 dB, the traveling wave ratio at the 75 ohm feed line input is about 0.6 and the back radiation level does not exceed -20 dB. The array is 1.06 m long and the directors extend 275 mm from each side of the center support beam. The analytical expressions for the antenna dimensions are supplemented with a drawing of the configuration of the array and instructions for set-up and alignment. Figures 3; references: 5 Russian.
[196-8225]

CERTAIN ASPECTS OF COMPUTER HARD AND SOFT WARE;
CONTROL, AUTOMATION, TELEMECHANICS,
TELEMETERING, MACHINE DESIGNING AND PLANNING

UDC 53.082.73

IMPROVING THE STABILITY OF AN AUTOMATIC CONTROL SYSTEM WITH A PIEZOELECTRIC BIMORPH PLATE

Leningrad IZV. VUZ: PRIBOROSTROYENIYE in Russian Vol 23 No 1, Jan 80 pp 36-41 manuscript received 8 Aug 78

GRUSHETSKIY, A. V., ZBORZHIL, B. and KAPTSOV, L. N.

[Abstract] Use of bimorph plates as sensors in automatic control systems offers a high sensitivity but also creates a problem of stability, inasmuch as such a plate which consists of two piezoceramic layers bonded so as to respond by flexure to application of an electric field constitutes a distributed vibratory system with natural frequencies. A structural analysis according to the small-deflection theory of thin plates and by the method of transfer functions reveals that segmentization of such a sensor cell can increase its stability by an order of magnitude. The piezoceramic sensor is segmented by cutting through the conductor layer, then voltage is applied directly from the amplifier to one segment but through a resistor to the other segment. An experiment with a cantilever bimorph plate of TsTS-19 ceramic and the conductor layer cut at 0.2:0.8 from the free end has confirmed the results of calculations. The paper was recommended by the Department (Kafedra) of General Physics and Wave Processes, Moscow State University imeni M. V. Lomonosov. Figures 4; references: 3 Russian, 1 Western, 1 Czech(?). [175-2415]

UDC 535.317:681.327

RING HOLOGRAMS OF ENCODER DISKS

Leningrad IZV. VUZ: PRIBOROSTROYENIYE in Russian Vol 23 No 1, Jan 80 pp 42-44 manuscript received 11 Apr 79

BAN'KOVSKAYA, YE. N., MAYOROV, B. A., OCHIN, YE. F., ROMANOV, YU. F. and TROFCHENKO, A. YU.

[Abstract] Recording the Fourier hologram of an N-digit binary encoder disk is considered, either with precise alignment of the object beam and the reference beam for coaxiality or with synchronous rotation of the hologram and the oblique restoring beam. The energy utilization factor (areas ratio of the readout disk sector to the entire restored image) is shown to be increased by insertion behind the objective of an axicon which forms a conical wave front. The image restored from a ring hologram thus obtained depends on the diameter of the restoring beam and, by rotating the hologram, one can successively restore different fragments of the disk in the same recording plane. In a reflection hologram the restored image of a disk fragment is either virtual or real, depending on the direction of the restoring beam. The paper was recommended by the Department (Kafedra) of Computer Engineering, Leningrad Institute of Precision Mechanics and Optics. Figures 2; references: 3 Russian.

[175-2415]

UDC 62-187.002.235:083.73

IMPROVING THE PRECISION OF ENCODERS

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 3, Mar 80 pp 23-24

MERTSALOV, V. M., VIDNER, N. YE., and DEMIN, K. YE., engineers

[Abstract] Precise encoding of graphical data is a part of computer-aided automatic design which facilitates direct programming and mathematical simulation even when the raw data are not mathematically describable. Two encoders are described which were developed at the Central Planning and Design Office of the Mathematical Academy (TsPkh MA) in Riga and which operate on somewhat different principles. The measuring device in the "Grafodat-P" is an X-Y plotter consisting of two printed-circuit boards on both sides of a dielectric plate with perforations. The coordinate grid is 500x500 mm² large, with 5x5 mm steps of the raster and raster increments by 75, 50, or

25 percent of this step when a microfield is used. The measuring device of the "Grafodat-I" is an X-Y plotter table on the flat surface of which originals are placed, a visor movable in the y-direction mounted on a cross-arm movable in the x-direction, and displacement counters in the form of optical converter disks driven by the visor through a tape mechanism. The two main sources of imprecision here are the finite number of pulses per disk revolution and the errors in the kinematic transmission. In many microprocessor applications it is expedient to operate in polar coordinates first and then transform to rectangular coordinates. With inductosyns more than 10,000 pulses per revolution are already attainable with a correspondingly very small angular error. In the meantime other electromagnetic readout devices are considered, which will eliminate kinematic linkages and errors associated with them. Tables 1.

(206-2415)

UDC 621.3.078

CHOICE OF THE MINIMIZING FUNCTIONAL IN THE ANALYTICAL DESIGN OF REGULATORS

Leningrad IZV. VUZ: PRIBOROSTROYENIYE in Russian Vol 23 No 1, Jan 80 pp 28-32 manuscript received 8 Jan 79

PIKHAY, A. G.

[Abstract] Under consideration is the synthesis of multiloop sequential-action relay-type regulators with controls of the $u^0 = \text{sign } b_k \sum_{k=1}^4 b_k y_k$ kind (y_k deviation of the k-th coordinate from its prescribed value, b_k constant coefficients). The analytical method of designing such a regulator is demonstrated in the specific case of a speed regulator for a d.c. electric motor, with control of the armature current through a diode rectifier. The design is based on a proper choice of the minimizing functional $J = \int V dt - \sum_{k=1}^4 a_k y_k^2 dt$ (a_k non-negative coefficients), i.e., the Lyapunov function V which optimizes the behavior of the controlled motor in terms of a system of four differential equations describing it: $u^0 = \text{sign } \frac{dy_k}{dt}$ ($k = 1, 2, 3, 4$). This is done according to the method of Ye. A. Barabashin [Punktsiya Lyapunova. Moscow, Nauka, 1970] with the aid of the determinant. The paper was recommended by the Department (Kafedra) of Electric Drives and Automation of Industrial Enterprises, Kommunarsk Institute of Mining and Metallurgy. Figures 2; references: 4 Russian.
(175-2415)

UDC 621.317:621.35

DISCRETE INFRALOW FREQUENCY DIFFERENTIATOR

Leningrad IZV. VUZ: PRIBOROSTROYENIYE in Russian Vol 23 No 2, Feb 80 pp 19-22 manuscript received 3 Mar 79

KONOVALOV, A. A.

[Abstract] The paper considers the principles of construction and operation of discrete infralow frequency differentiators which use electrochemical silver-chloride integrators with discrete readout as an element for gathering, storage and processing of data. A block diagram, time charts, and the results of tests are presented. The differentiator described can be used in the development of equipment for optimalizing control and automatic forecasting during the solution of a wide class of problems which have an important practical value--weather forecasting, earthquakes, level of subsoil water, analysis of the parameters of the environment and others. The paper was recommended by the Department (Kafedra) of Labor Protection, Leningrad Institute of Aviation Instrument Building. Figures 2; references: 3 Russian. [6415-193]

UDC 621.396:519.25

TRACKING INTERRUPTION IN SYSTEM WITH SECOND-ORDER FILTER

Kiev IZV. VUZ: RADIODELEKTRONIKA in Russian Vol 23 No 1, 1980 pp 60-65 manuscript received 22 Jan 79

RESHETNYAK, S. A. and TRET'YAKOV, G. N.

[Abstract] In view of the importance of analyzing the influence of initial conditions on the probability of tracking interruption, and because tracking usually begins under arbitrary initial conditions, the effect of initial conditions is analyzed by a quasi-stationary probability density technique for a dual integrator tracking system under arbitrary initial conditions. An expression is derived for the uniform probability density of tracking errors as an infinite power series in terms of a certain evolution operator, and the conditions under which the series can be abbreviated. An expression is derived on the basis of the first-order quasi-stationary probability density for the tracking interruption probability and the results are substantiated by computer modeling. Truncation of the infinite series is based on the fact that after a while the system forgets information about the initial interruption probability density. Figures 2; references: 6 Russian. [158-7872]

UDC 681.3.05+681.2+621.391

'OPTAN' AUTOMATIC DESIGN SYSTEM FOR ANALOG-TO-DIGITAL CONVERTERS

Leningrad IZV. VUZ: PRIBOROSTROYENIYE in Russian Vol 23 No 1, Jan 80 pp 56-58 manuscript received 15 Mar 79

NOISEYEV, V. S., TUCHKOV, A. A. and KOZHENKO, S. M.

[Abstract] The automatic design system OPTimization and ANalysis has been developed for solving problems in the internal and external design of analog-to-digital converters. Input data in the text are processed by a translator, with concurrent printout revealing any syntactic errors. In the machine language, the data now proceed to the editor and from there through four successive program decks: 1) Calculation of internal and external device parameters; 2) Inspection of the values of parameters for consistency; 3) Generalization of parameters; and 4) Optimization of the device on the basis of generalized parameters. The system also includes a control program. With this software, a Ye8 1022 Unified System computer can solve within 5 minutes a moderately complex problem such as selection of the optimum converter design from among 10 variants. Availability of a convenient input language reduces the time of text writing to not more than 30 min. The paper was recommended by the Department (Kafedra) of Computer Techniques, Leningrad Institute of Precision Mechanics and Optics. Figures 1; tables 3; references: 1 Russian. [179-2415]

UDC 681.14

A DEVICE FOR FAST TRANSFORMATION OF COORDINATES

Leningrad IZV. VUZ: PRIBOROSTROYENIYE in Russian Vol 23 No 1, Jan 80 pp 50-53 manuscript received 11 Jul 77

NEMYTOV, B. V. and ORANSKIY, A. M.

[Abstract] Fast transformation of coordinates on the basis of the CODIC system according to J. B. Volder is demonstrated on transformation of the Cartesian coordinates of a point to its polar coordinates. The algorithm is implemented by a device which includes an x_1 -register, a y_1 -register, two shift registers for forming $x_1 2^{-i+1}$ and $y_1 2^{-i+1}$ respectively, two adders, a permanent memory for storing the constants $b_1 = \tan^{-1} 2^{-i+1}$, another adder, and a control module. It transforms coordinates $M(x, y, z)$ to coordinates $M(r, \theta, \alpha)$ by two successive iteration cycles, first in the horizontal plane

and then in the vertical plane, in order to obtain successive solutions to two systems of corresponding recurrence relations. The speed of this device has been further increased by elimination of two division operations, the iteration process being organized so as to yield a vector deformation factor closest to 2. An inverse transformation of coordinates can be performed with the same device. The paper was recommended by the Department (Kafedra) of Automatic Control Systems, Republic Interindustry Institute for Upgrading the Qualifications of Management Personnel and Specialists in the National Economy, Minsk. Figures 2; references: 5 Russian, 1 Western. [175-2415]

UDC 681.32

MACHINE DESIGN OF DIGITAL RIPPLE FILTERS

Leningrad IZV. VUZ: PRIBOROSTROYENIYE in Russian Vol 23 No 2, Feb 80 pp 15-19 manuscript received 13 Jun 79

KACHURIN, V. N. and GUBIN, A. N.

[Abstract] Methods of optimization and an algorithm of organization of computing processes are presented which make it possible completely to automate on a computer the complex processes connected with the design of digital filters for a widespread class of random signals. The paper was recommended by the Department (Kafedra) of Computing Techniques, Leningrad Electrical Engineering Institute imeni V. I. Ul'yanov (Lenin). References: 3 Russian, 1 German. [6415-193]

IMAGE INPUT-OUTPUT DEVICE FOR A UNIFIED SYSTEM COMPUTER ON THE BASE OF THE SCANNER IN R-1700 "PHOTOMATION" EQUIPMENT

Leningrad IZV. VUZ: PRIBOROSTROYENIYE in Russian Vol 23 No 2, Feb 80 pp 48-51 manuscript received 23 Nov 78

ZAYTSEV, V. N. and CHIGIREV, A. A.

[Abstract] An image input-output unit with electromechanical scanning of the drum type for a unified system computer, and its functioning are described. The unit was developed on the base of the scanner in the R-1700 "Photomation" equipment produced by the Optronics firm. A block diagram and the following principal parameters are shown:

Maximum size of image	220 x 230 mm
Dimensions of the composite element	25 x 25; 50 x 50; 100 x 100 micrometer
Range of optical densities	
with readout 0 + 2D and 0 + 3D	
with reproduction 0 + 2.5D	
Number of levels of quantization	256
Number of reproducible graduations	64
Time of input (output) of image	
with a dimension of 220 x 230 mm with an aperture	
25 micrometer	96 minutes
50 "	24 minutes
100 "	6 minutes

The image input-output unit has successfully been exploited since 1977. The paper was recommended by the Department (Kafedra) of Computer Techniques, Leningrad Institute of Precision Mechanics and Optics. Figures 1; references: 3 Russian.

[6415-193]

UDC 681.325.3

THREE-READING ANGLE-CODE CONVERTER FOR COUPLING GYROCOMPASS WITH COMPUTER

Leningrad IZV. VUZ: PRIBOROSTROYENIYE in Russian Vol 23 No 2, Feb 80 pp 43-47 manuscript received 18 May 79

BASKAKOVA, I. V., GOLOVINA, L. I. and MEYER, V. V.

[Abstract] The possibility is shown of converting information concerning course into digital form by equipping a standard gyrocompass repeater with a two-reading system for space coding of the angular positions of the repeater scales on the base of magneto-controlled contacts, in combination with a converter of the phase voltages of a selsyn-receiver in a time interval and subsequent conversion of the latter into digital code as an analogue of the scale of the vernier readout. The "digital repeater" (the three-reading angular-position quantizer developed on the base of a standard repeater) can be realized in practice for any type of gyrocompass, the signals in the line of synchronous selsyn transmission of which correspond to the value $C_H = 1$ revolution per degree and the value of the revolutions of the compass card for coarse and precise reading are equal respectively to $C_{coarse} = 1/360$ and $C_{precise} = 0.1$ revolutions per degree. A minimization is made of the structure of the angular-position quantizer with the object of reducing the equipment cost. Operation of the digital repeater during the course of 2,000 hours under marine conditions on two scientific-research ships showed that the root-mean-square error, and the determined statistical processing of the histograms of distribution of current errors of readout did not exceed 1.4 angular minutes with a three-scale readout and 15' with a two-scale readout of the summator output. The paper was recommended by the Department (Kafedra) of Designing and Computing Equipment, Ryazan' Radio Engineering Institute. Figures 1; tables 1; references: 4 Russian.
[6415-193]

A LASER PRINTER DEVELOPED IN THE HUNGARIAN PEOPLE'S REPUBLIC

Moscow Pribory i Sistemy Upravleniya in Russian No 3, Mar 80 pp 28-29

TEKES, S., and BERBEKAR, D., engineers

[Abstract] The first laser printer was put on the market by IBM in 1965. Various other laser printers, in combination with electrophotographic processing and with matrix rather than mechanical formation of characters, have since been developed by other firms. Following the resolution adopted by the Hungarian State Committee for Technical Development in 1975, another laser printer is being developed by the Research Institute of Computer Engineering and Automation at the Hungarian Academy of Sciences, jointly with the Hungarian Optical Works and enterprises engaged in engineering and precision mechanics. After 2 years of research and development work in the first stage of the project, a laboratory prototype was built in 1977 for evaluation. It has been in service for over a year now and is used for further experimental work. Tables 1.

[206-2415]

CERTAIN ASPECTS OF PHOTOGRAPHY, MOTION PICTURES AND TELEVISION

UDC 621.385.832.5

A DEVICE FOR ANALOG-DIGITAL STABILIZATION OF THE RASTER POSITION AND DIMENSIONS IN TELEVISION TUBES

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 3, Mar 80 pp 56-58

KOLBAS, S. V. and TURCHENKOV, L. P., Tomsk Institute of Automatic Control Systems and Radioelectronics

[Abstract] Stabilizing the raster position and dimensions on the target of a television transmitter tube is more reliable with a reference image than by time staggering of the test-image signals or by analysis of the main test-image signal at the tube output. Here a device for self-stabilization is described which includes four independent channels for stabilizing the vertical position, the vertical dimension, the horizontal position and the horizontal dimension, respectively. It operates in a system where the test signal from the output of the camera amplifier passes through a time selector and a filter before it is loaded with pulses and converted to a control voltage, while reference data are recorded in a computer. The conversion occurs in the channels, each consisting of a coincidence circuit followed by a register and then a digital-to-analog converter, after the loading pulses have been fed to reversible counters: one for both vertical stabilization channels and one for both horizontal stabilization channels. All components are synchronized and synphased by a commutator array and by entry of a nominal number in the multidigit counters. Figures 3; references 4: 2 Russian, 2 Western.

[215-2415]

UDC 621.385.832.564.4

MINIATURE VIDICON LI465 WITH ELECTROSTATIC FOCUSING AND DEFLECTION OF THE ELECTRON BEAM

Moscow TEKHNIKA KINO I TELEVIZIYA in Russian No 3, Mar 80 pp 52-53

GERSHBERG, A. YE. and MARKIZOV, A. S.

[Abstract] A half-inch vidicon with electrostatic focusing and deflection of the electron beam has been built where aberrations caused by a small space-charge region and less precise dimensions of the electrodes are held to a minimum. The tube is 13.5 mm in diameter and 102 mm long, the target has an active area of 4.9x6.5 mm². The cathode is rated for 0.6 W, the anode voltage is 300 V, the maximum grid voltage is 600 V. Frame and line deflection of the electron beam are effected respectively by two pairs of plane-parallel plates, one behind the other along the tube axis. The maximum alternating voltage applied to each is not higher than 50 V. The illumination level in the camera must be regulated in order to ensure a wider dynamic range, inasmuch as charge compensation on the target by the electron beam alone is not adequate. The sensitivity spectrum covers the entire visible range, with a peak at the $\lambda = 680$ nm wavelength, and the maximum attainable resolution is approximately 90 lines/mm. The persistence is 18 percent within 40 ms and only 5 percent within 200 ms because the low level of target illumination. The resolution can be increased by means of an additional focusing dc voltage varying parabolically in synchronism with the line deflection voltage, or even further by means of dynamic focusing with such a parabolically varying voltage and a linearly varying voltage. The structure of this LI465 vidicon is vibration resistant over the 1-1000 Hz frequency range and up to 10 g acceleration. The device operates at temperatures from -60 to +60°C, under pressures as low as 5 mm Hg, and at 98 percent humidity at 35°C. The minimum life is 1000 h. Its sensitivity and other photoelectrical characteristics are better than those of the British EMI Co. Ltd. model D2003. Figures 2; references: 1 Russian.
[215-2415]

UDC 621.397.61:681.772.7

MODULATION CHARACTERISTICS OF SINGLE-LINE TELEVISION SYSTEMS BUILT ON
DEVICES WITH CHARGE COUPLING

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 3, Mar 80 pp 49-52

FRIDMAN, A. N. and YAKOVLEV, S. B., Scientific Research Institute of Tele-
vision, Moscow

[Abstract] Distortionless data transmission in single-line television sys-
tems with mechanical scanning is considered in terms of resolving power.
This parameter is determined by a modulation characteristic defined and
calculated here in terms of the Fourier transform of the sensitivity distri-
bution over a field structure built on devices with charge coupling. An
analysis of the frame sweep process in such a system indicates that equal
modulation characteristics along both coordinates at the maximum space fre-
quency are attainable by shortening the dimension of light-sensitive elements
in the direction of the sweep, also by shortening the charge accumulation
time and slowing down the image movement. Also considered is a structure
with time delay and charge accumulation, where inequality of the image veloci-
ty and the charge velocity constitutes the main constraint on the choice of
the number of delay and accumulation lines. This is demonstrated on the
modulation characteristics of 2-, 3-, and 4-phase registers of vertical
frame transport. Figures 5; references: 2 Russian, 2 Western.

[215-2415]

UDC 778.24:778.534.1

A LIGHT TRANSMITTING STEREO SCREEN

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 3, Mar 80 pp 10-12

BELOUSOV, B. I. and VISHNEVSKAYA, G. A., All-Union Scientific-Research In-
stitute of Motion Picture Photography

[Abstract] A light transmitting stereo screen with stereoscopic projection
is described where each raster consists of conical lenses which form a peri-
odic array of conical surface segments converging toward the dome point.
Formation of a principal and parasitic Moire patterns by modulation of light
coming from an image of fringes is considered and the scattering indicatrix
of this screen is calculated. The screen has an area of 900x1200 mm², its
rasters have periods and focal lengths of 0.80 mm, 23 mm respectively in the

lower cross section and 1.4 mm, 40 mm respectively in the upper cross section. The separation factor is 84 percent. The screen was used with a 9-objective projector. Its frame had been designed by M. B. MEYERZON at the Experimental Production Laboratory of the Institute. Experiments were performed with the assistance of V. A. DERZHAVIN and A. YA. MUT'KOV. Figures 6; references: 6 Russian.
[215-2415]

UDC 778.53:621.37/.39

OUTLOOK FOR DEVELOPMENT, IMPROVEMENT AND APPLICATION OF ELECTRONICS AND TELEVISION IN MOTION PICTURE TECHNIQUES

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 3, Mar 80 pp 27-30

ANTIPIN, M. V. and GOLOD, I. S., Leningrad Institute of Motion Picture Engineers

[Abstract] Present trends indicate that electronics and television will play an increasing role in the motion picture industry, from initial screen tests to final showing and transcription, through the various stages of film production and processing as, for instance, chemico-photographic processing of color films. Involved with this will be further development and improvement of cinematographic techniques themselves, including control and automation. For the next 10-12 years the use is foreseen of videomagnetic tape for production of negatives as well as repetitive and checking operations in the studios, the use of television facilities for remote control as well as simulation of the positive color-photographic process, and the use of lasers for film showing. Within 18-20 years from now the use is foreseen of magnetic video recording for television film production as well as for scientific, popular science and documentary films. No particular innovations and outlays for re-equipment are foreseen here in the area of art films. After the year 2000 there will have been developed and established an international standard for television motion pictures with a wider frequency range, allowing for production of images on videomagnetic tape not inferior to those produced now on 35-mm film. Lasers will be used for showing art films in color, with the aid of video signals coming from one distribution center to several theaters. In the meantime, the quality of materials will become higher and the reliability of equipment as well as the quality of images will have made large-scale film printing feasible. References: 18 Russian.

[215-2415]

PROJECTION OF SPATIAL IMAGES ON A TRANSLUMINANT SCREEN WITH A HEXAGONAL RASTER

Moscow TEKHNIKA KINO I TELEVIZIYA in Russian No 3, Mar 80 pp 13-16

AKIMAKINA, L. V. and KOMAR, V. G., All-Union Scientific Research Institute of Motion Picture Photography

[Abstract] A drawback of the meshless 3-D cinema developed by S. P. Ivanov, using lens-raster screens and a single stereoscopic pair of images in filming and projection, is the necessity of selecting and maintaining a definite position for the viewer. This problem has been overcome by integral filming and projection of stereoscopic images, or by filming and projection of a single spatial image of the object with a raster consisting of cylindrical or spherical lenses. A raster film and a universal technology for producing large transluminant raster screens on the basis of a hexagonal structure have been developed. The feasibility of projecting spatial holographic images on such screens has also been established. Here the principles of point focusing of sagittal and meridional rays is demonstrated, including the effect of lens manufacturing error on image blurriness and the dependence of the angular resolution on the object displacement. This analysis as well as experimental holographic projection, made with a special objective (focal length 251 mm and relative aperture 1:1.3), indicate the feasibility of showing on such a screen high-quality bright pictures to a large group of viewers in different positions. Figures 8; references: 8 Russian.

[215-2415]

CIRCUIT THEORY AND PRACTICE

UDC 621.317.373

APPLICATION OF OPERATIONAL AMPLIFIERS FOR MEASUREMENT OF PHASE DISPLACEMENT BY THE RATIO OF TWO FREQUENCIES

Leningrad IZV. VUZ: PRIBOROSTROYENIYE in Russian Vol 23 No 2, Feb 80 pp 68-72 manuscript received 8 Aug 78

SHEOL'NIK, V. N. (deceased)

[Abstract] An electrical circuit based on operational amplifiers is investigated. Use of the circuit makes it possible to simplify the process of determining the phase displacement angle by the ratio of two frequencies. A block diagram is presented in which a switch circuit represents a polar-coordinate compensator. The phase displacement angle is regulated with the assistance of a T-shaped quadrupole, the branched part of which is connected in parallel with the operational amplifier. The paper was recommended by the Electrical Engineering Department (Kafedra) of the Sverdlovsk Mining Institute imeni V. V. Vekhrusheva. Figures 3; references: 3 Russian. (6415-193)

UDC 621.391.823:64:621.313.13.36

STANDARD CIRCUITS FOR SUPPRESSION OF INDUSTRIAL RADIO INTERFERENCE FROM ELECTRICAL HOME APPLIANCES WITH COMMUTATOR MOTORS

Moscow ELEKTROTEKHNIKA in Russian No 3, Mar 80 pp 21-23 manuscript received 11 Jun 79

TURIN, L. S., engineer

[Abstract] Electrical home appliances with commutator motors constitute the largest group of interference sources in the proximity of communication (radio and television) receiver equipment. The interference voltage can reach levels of 70-100 dB in the 0.15-0.5 MHz frequency range and 60-90 dB in the 0.5-30 MHz frequency range. The permissible levels are 60 and 52 dB

respectively. The effectiveness of interference suppression must, therefore, be 10-40 dB. Suppression circuits are tested under a load in the form of an open-delta equivalent network with an 150Ω impedance of each arm to the common ground. Various standard suppression circuits are available. Single symmetric capacitors are adequate for suppressing light interference in the lower frequency range, the capacitor size depending on the required attenuation-frequency characteristic. Composite capacitive filters consisting of a symmetric capacitor in parallel with two asymmetric capacitors are needed for suppressing heavier interference in the upper frequency range. Still more effective interference suppressors are the more intricate capacitive-inductive filters in appropriate configurations for low-impedance ($Z_1 \leq 150\Omega$) and high-impedance ($Z_1 \geq 150\Omega$) interference sources. In these devices ceramic capacitors and toroidal Permalloy, Alsifer, or Ni-Zn ferrite cores are now used. Additional shielding of appliances with commutator motors is required in the case of a nonmetallic housing. Metal coating of the inside surface is the most thorough and effective here. Figures 6; references: 4 Russian. [205-2415]

COMMUNICATIONS; COMMUNICATION EQUIPMENT INCLUDING RECEIVERS
AND TRANSMITTERS; NETWORKS; RADIO PHYSICS; DATA TRANSMISSIONS;
INFORMATION THEORY

UDC 621.353.52

NOISE CHARACTERISTICS OF PHOTODIODE RECEIVERS IN OPTICAL COMMUNICATIONS
SYSTEMS

Kiev IZV. VUZ: RADIOTEKHNIKA in Russian Vol 23 No 1, 1980 pp 38-44
manuscript received 16 Oct 78

KORNEYCHUK, V. I.

[Abstract] The dependence of the noise characteristics of photodiode analog receivers on the passband is analyzed for the purpose of determining whether an ordinary photodiode or an avalanche photodiode should be used as the photoelectric converter, and whether a field effect transistor or a bipolar transistor should be used as the amplifier. The equivalent diagram is presented of the photodiode receiver which consists of a serially connected photodiode of the p-n or p-i-n type and a negative feedback amplifier. The photodiode-FET and photodiode-bipolar transistor systems are analyzed and compared in three frequency ranges. The FET receiver has better performance characteristics than the bipolar transistor receiver in the frequency band up to 12 MHz. Figures 3; references: 5 Russian, 3 Western.
[158-7872]

UDC 621.372.061

STABILITY AND INSTABILITY RANGES OF GENERALIZED SWITCHED DUAL INTEGRATOR
TRACKING SYSTEM

Kiev IZV. VUZ: RADIOTEKHNIKA in Russian Vol 23 No 1, 1980 pp 66-70
manuscript received 13 Nov 78

GOSTEV, V. I.

[Abstract] The precise stability and instability ranges of a generalized switchable dual integrator tracking system with a finite sampling time are determined. The receiver is gated during the pause between two pulses.

and as a result of gating the fluctuation interference at the discriminator output is converted to a sequence of noise pulses. The discriminator is assumed to have a linear response for small errors. The stability ranges, found as a result of the analysis, determine the values of the parameters for which a system is functional. Figures 3; references: 4 Russian.
(158-7872)

UDC 621.391.2

BINARY PERIODIC SEQUENCES WITH SMALL LOSSES TO SIDE LOBE SUPPRESSION

Kiev IZV. VUZ: RADIOTEKHNIKA in Russian Vol 23 No 1, 1980 pp 20-25
manuscript received 13 Oct 78

IPATOV, V. P.

(Abstract) Binary digital signals, generated by coding the elements of q -nary M-sequences with ± 1 symbols, are described. A procedure for synthesizing coding rules, capable of perfect side lobe suppression with minimum losses in the threshold signal, associated with linear side lobe suppression, is explained. Examples are presented of new families of sequences that are better in this respect than families known heretofore. The losses of the coding rules with certain parameters, calculated both for finite, and for infinite lengths, are compared and an algorithm for generating the described sequences is explained. A standard M-sequence generator with a q -nary shift register and linear feedback and logic converter may be used for generating sequences of the described class. Tables 1; references: 6 Russian.
(158-7872)

UDC 621.391.8

TECHNIQUE FOR SUPPRESSING SELECTIVE AND PHASE SHIFT-KEYED INTERFERENCE IN COHERENT RECEPTION OF RADIO TELEGRAPH SIGNALS

Kiev IZV. VUZ: RADIOTEKHNIKA in Russian Vol 23 No 1, 1980 pp 26-31
manuscript received 20 Oct 78; after revision 16 Apr 79

PODDUBNYY, V. N. and BAZYKIN, V. V.

[Abstract] A method of suppressing selective and PSK interference in coherent radio telegraph reception of phase shift-keyed, phase differential modulated and amplitude-modulated signals, based on measurement of the current levels of the quadrature components of interference with a receiver and subsequent transmission of the signal through a quadrature channel with a lower level of interference, is examined as an alternative to suppression based on the filtering or compensation of these types of interference. A return channel is used for transmitting commands to change the initial phase of the radiated signal, which permits the use of the described method in two-way communications channels. A procedure for measuring the quadrature components of interference is suggested for the purpose of selecting the better of two quadrature channels with phase detectors. The effect of correlated normal interference, harmonic interference and PSK interference on the error probability is examined. The described adaptive communications system offers satisfactory reception when a nonadaptive system does not, and the gain in the quality of reception increases with the signal to noise ratio. Figures 3; references: 3 Russian.

[158-7872]

UDC 621.394.1:591.216

OPTIMAL SIGNAL PROCESSING IN COHERENT MULTIPONT RECEPTION WITH A BACKGROUND OF INTRINSIC AND EXTRINSIC NOISE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24 No 12, Dec 79 pp 2470-2487
manuscript received 12 Apr 78

KREMER, I. YA. and NAKHMANSON, G. S.

[Abstract] Coherent multipoint reception of signals is considered, i.e., signals appearing together with intrinsic noise in the equipment and extrinsic noise due to a concentrated source. Into account are taken the directness of the antenna system where a few antennas have been spaced far apart,

the time shift between complex signal envelopes and the unequality of signal energy levels at different points, as well as the inapplicability of the Fresnel approximation to antenna systems with dimensions comparable with their distance from the signal source. An algorithm of signal processing, optimal with respect to the likelihood ratio, is constructed for a system of n receiver antennas in one XY plane and a point target which isotropically reflect signals from a transmitter antenna in the same XY plane. The useful signal reflected from the target is assumed to propagate without distortions, and the radiation patterns of all receiver antennas are assumed to be identical and uniform within the operating sector of the angular coordinates. The signal-to-noise ratio at the output of the processor is calculated and the potential accuracy of measurement of the target coordinates is estimated using Fisher's inverse information matrix. The output signal-to-noise ratio is, in the presence of extrinsic noise, found to be an oscillatory function of the target distance and to depend on the spacing of the receiver antennas. The accuracy of target ranging is improved by inclusion of data on the curvature of the wave front in the Fresnel zone and as the extrinsic target noise increases relative to the intrinsic equipment noise. Figures 6; references: 7 Russian.
(204-2415)

UDC 621.394.662.2

REFERENCE SYNCHRONIZATION OF MULTIPLE PHASE SHIFT-KEYED BAND SIGNALS

Kiev IZV. VUZ: RADIODELEKTRONIKA in Russian Vol 23 No 1, 1980 pp 45-48
manuscript received 13 Nov 78; after revision 30 Jan 79

ZAKHAROV, I. I. and KURITSYN, S. A.

[Abstract] An analytical expression is derived for the minimum mean square error of reference frequency phase control for a modified phase automatic frequency control algorithm on the basis of a selected mean square criterion. An additive signal-noise mixture is used as the narrow-pass converter input signal. The investigated gradient phase automatic frequency control algorithm is better than the traditional algorithm because it completely eliminates the phase error, attracts a linear change of the phase error and places no constraints on the initial tolerable phase error. Figures 3; references: 2 Western.
(158-7872)

UDC 621.396.67.001.24:778.38

PRODUCING RADIO IMAGES OF OBJECTS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24 No 12, Dec 79 pp 2454-2463 manuscript received 20 Feb 78

CHERNYAK, V. S.

[Abstract] Radioholography is considered as a method of reconstructing the radio image of an object which scatters the field of a wideband signal impinging on it. Calculating the scattered field with a generally different polarization in a physical-optics approximation reduces to evaluation of an integral which can be regarded as a Fourier transform. The radio image is to be reconstructed, i.e., the scattering function is to be estimated from the realization of the sum of a signal and a Gaussian stationary noise measured over a finite period of time at a finite aperture. Assuming the noise to be delta-correlational in both space and time, the algorithm involves an inverse Fourier transformation with selection of a proper simple stabilizing multiplier so that matched filtration will follow and the algorithm becomes quasi-optimal. Here the procedure according to this algorithm is demonstrated first on simple single-point reception of a monochromatic signal and of a wideband signal, then on more general multipoint reception of a monochromatic signal and a wideband signal. In the most general last case there arises the problem of volume resolution. Accordingly, three-dimensional "radiovision" of objects requires that their characteristic dimension be at least a few times larger than the length of the resolution elements. References: 7 Russian, 5 Western (two in translation).

(204-2415)

UDC 621.396.94:537.874.3

EXPERIMENTAL STUDY OF REFRACTION OF OPTICAL AND RADIO WAVES ALONG GROUND PATHS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24 No 12, Dec 79 pp 2440-2446 manuscript received 12 Jun 78

BADULIN, N. N., YEROKHIN, A. V. and MASALOV, YE. V.

[Abstract] An experimental study was made of vertical refraction of electromagnetic waves entering the ground layer above a nonhomogeneous surface. Fluctuations of the vertical incidence angle and of the gradient of the refractive index were measured during the 1976-77 period, in winter (March).

and in summer (July). Measurements pertaining to radio waves ($\lambda = 3$ cm) were made by scanning a narrow beam in the vertical plane, over 7-50 km long open ground paths, with an rms error not exceeding $1.3'$. Measurements pertaining to optical waves were made with an OT-02 theodolite by standard geodetical procedure, over 8 and 22 km long paths, with an error not exceeding $3''$. Auto-correlation functions and correlation intervals were then calculated from the data in the course of a statistical analysis, for estimating the spectral content of the fluctuations. Fluctuations of the incidence angle are found to be periodically nonstationary, with an asymmetric distribution. Correlation intervals are found to vary from 2 to 5 h. Noteworthy is the revelation of a diurnal cycle with predominantly stronger refraction during the night. The dependence of the correlation intervals on meteorological conditions and on wave path parameters cannot yet be established. Figures 5; tables 2; references: 10 Russian.
[204-2415]

UDC 621.396.96

OPTIMIZATION OF PARAMETERS OF LOCK-ON INDICATOR

Kiev IZV. VUZ: RADIODEKTRONIKA in Russian Vol 23 No 1, 1980 pp 95-96 manuscript received 9 Nov 78

LUZIN, V. I., NIKITIN, N. P. and TIMOFEEV, O. A.

[Abstract] Equations are derived for optimizing the parameters of a lock-on indicator, the narrow-pass filter of which is assumed to have a rectangular frequency response, and the balance system maintains the mixed output signal and noise power equal to the balance level. The optimum dimensionless passband of the narrow-pass filter is plotted as a function of the correct detection and false alarm probabilities. The narrow-pass filter with the optimum passband in a quasi-optimum lock-on indicator with a balance system of the fast automatic gain control type produces about an 8 dB energy loss in comparison with a correlation detector for a completely known simple signal. Figures 2; references: 2 Russian.
[158-7872]

UDC 621.391.8:510.5

A QUASI-OPTIMAL DETECTION ALGORITHM FOR A DETERMINISTIC SIGNAL APPEARING WITH NONCAUSSIAN INTERFERENCE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25 No 2, Feb 80 pp 304-312 manuscript received 8 Jan 79

PYSHKIN, I. M. and CHVILEV, G. D.

[Abstract] The problem of detecting a signal which appears with interference in radio systems operating under conditions of a priori indeterminacy can be reduced to calculating the likelihood ratio and comparing that with the threshold. In the case of nongaussian interference it becomes easier to consider a multialternative situation at the receiver input. Here a signal is assumed to appear together with additive interference consisting of white Gaussian noise and interstation interference. A table of four states with corresponding four hypotheses and four a priori probabilities is, by proper assignment of penalty values, reduced to two nonintersecting sets of two subsets each. An algorithm of calculating the respective likelihood ratios in logarithmic and explicit forms is shown for the case of an inertialess nonlinear element. The detector structure is designed which realizes this algorithm and its interference immunity is calculated in terms of error probability and signal-to-noise ratio at the output of the nonlinear element. The authors thank O. A. SHORIN for the assistance in this study. Figures 4; references: 4 Russian.

[189-2415]

COMPONENTS AND CIRCUIT ELEMENTS, INCLUDING
WAVEGUIDES, CAVITY RESONATORS AND FILTERS

UDC 681.325.5

SYNTHESIS OF DIGITAL FILTERS WITH PRESCRIBED AMPLITUDE-FREQUENCY CHARACTERISTICS BY METHODS OF LINEAR PROGRAMMING

Leningrad IZV. VUZ: PRIBOROSTROYENIYE in Russian Vol 23 No 1, Jan 80 pp 13-17 manuscript received 29 Dec 78

GOL'DENBERG, L. M., POLYAK, M. N. and PEROV, V. G.

[Abstract] The first step in synthesizing a digital filter is approximately to determine its transfer function on the basis of the prescribed requirements regarding the amplitude-frequency characteristic. According to the procedure proposed here, it is necessary to begin by approximating the square of its modulus with a fractional-rational function of $\cos j\omega T$, then change to mirror-symmetric polynomials, determine their poles and zeros, discard all those which do not satisfy the stability criterion, and finally from the remaining ones construct the transfer function. The problem, one of nonlinear programming with appropriate constraints, is reduced to one of linear programming by introduction of an extra variable. The 14-step algorithm of its solution by the simplex method, with the optimum (Chebyshev) approximation sought, not over the entire $(0, \pi)$ range but on a finite grid of discrete points only, has been written in FORTRAN-4 for implementation on a computer. The method is suitable for synthesis of recursive as well as nonrecursive digital filters, as well as transfer functions with the numerator of a higher degree than the denominator, and of devices other than filters with prescribed frequency characteristics. The paper was recommended by the Department (Kafedra) of Pulse and Computer Engineering, Leningrad Institute of Electrical Communications Engineering imeni prof M. A. Bonch-Bruevich. Figures 1; references: 7 Russian.
[175-2415]

UDC 621.391.2

SELF-TUNING SYNCHRONOUS REJECTION FILTER

Kiev IZV. VUZ: RADIOTEKNIKA in Russian Vol 23 No 1, 1980 pp 82-85
manuscript received 14 Jul 78; after revision 10 May 79

KUZ'MINSKIY, A. M.

[Abstract] An algorithm for a self-tuning synchronous rejection filter that is easy to run in the absence of a reference signal is formulated and the sufficient conditions under which it is stable are determined in the interest of designing self-tuning noise suppressors based on synchronous filters, the parameters of which are easy to control. The design of a self-tuning synchronous rejection filter for suppressing quasi-periodic interference with unknown parameters in an additive mixture with a wide-band random signal is illustrated. The signal and interference are assumed to be uncorrelated. The resonance frequency of the recursive filter is tuned to the frequency of interference by a phase automatic frequency control system. The algorithm developed in the work performs effective self-tuning and can be used for designing a simple adaptive synchronous filter. Figures 2; references: 6 Russian, 1 Western.

[158-7872]

UDC 621.372

DIGITAL RESONATOR WITH LIMITED IMPULSE RESPONSE

Leningrad IZV. VUZ: PRIBOROSTROYENIYE in Russian Vol 23 No 2, Feb 80 pp 7-10
manuscript received 13 Jul '79

STEPASHKIN, A. I. and ALPATOV, B. A.

[Abstract] The method of frequency selection with the use of a series connection of a comb filter and a set of parallel connected recursive cosine resonators is an effective approach to the construction of digital narrow-band filters. However, realization of known cosine resonators encounters serious difficulties because of the requirement for a large class of coefficient representation. The present paper considers another algorithm of operation of cosine resonators with limited impulse response which to a considerable degree is free from this shortcoming. The necessary order of presentation of modulating harmonic functions required is evaluated. The paper was recommended by the Department (Kafedra) of Automatics and Telemechanics, Ryazan' Radio Engineering Institute. Figures 1; references: 2 Russian. [193-6415]

CONVERTERS, INVERTERS, TRANSDUCERS

UDC 621.314.632.001.4

A CONVERTER WITH SYMMETRIC TRIODE THYRISTORS IN A 3-PHASE BRIDGE CIRCUIT

Moscow ELEKTROTEKHNIKA in Russian No 3, Mar 80 pp 45-48 manuscript received 16 Apr 79

SHEVCHUK, S. N., doctor in technical sciences, Professor, and KIRIYENKO, V. P., candidate in technical sciences

[Abstract] A converter with symmetric triode thyristors in a 3-phase bridge is examined, and its performance is analyzed through changes of the load current from the limiting continuous-duty level to short circuit. Symmetric 3-phase line voltages and zero voltage drops across the thyristors are assumed for simplification. A thyristor is turned on at the instant a control pulse appears at its gate, and the control angle is maintained constant. The resistance of the commutation circuit is negligible and the inductance of the load circuit is infinitely large. In the initial stage of current increase the thyristors operate, as in other converters, alternately in groups of two and three. As the commutation angle reaches 60° , in this converter the thyristors begin to operate alternately in groups of four and three and two when the control angle is smaller than 30° and the control pulse is narrower than 15° , or alternately in groups of four and three only under heavy loads when the control angle is $30-60^\circ$ and the control pulse is wider than 15° . The external voltage-current characteristics of this converter are described by straight lines in each mode of continuous-duty operation. They have been calculated on the basis of equivalent-circuit diagrams and relations. They are accurate within 5-7 percent, according to oscillograms taken in an actual experiment. Figures 4.

[205-2415]

UDC 621.317.725

A HIGH-SPEED CURRENT TRANSDUCER WITH SENSITIVITY ADAPTATION

Leningrad IZV. VUZ: PRIBOROSTROYENIYE in Russian Vol 23 No 1, Jan 80 pp 71-74 manuscript received 13 Oct 78

PRYANISHNIKOV, V. A., PETROV, YE. A. and GUBANOV, N. N.

[Abstract] An electronic current transducer with sensitivity adaptation has been developed which combines high speed and a high degree of linearity. This is achieved by paralleling the range limit selection with twofold conversion of the input current, first by an amplifier which converts current I_x to a voltage proportional to $\log I_x$ and then by an amplifier which converts this voltage to one proportional to I_x . The device also includes a controllable bias voltage supply for scale changes and a decoder. All components are built with integrated microcircuits. Both amplifiers have transistors in their feedback loops, and the bias voltage supply consists of four transistor stages. Excellent experimental results have been obtained with K1NT591 or KT118 IC transistor pairs for the two amplifiers. The paper was recommended by the Department (Kafedra) of Electrical Engineering, Leningrad Institute of Precision Mechanics and Optics. Figures 2; references: 3 Russian.

[175-2415]

UDC 621.373.43:621.382.233.026 .001.5

A THYRISTOR-TYPE PULSE SHAPER WITH A TRANSFORMER OUTPUT STAGE

Moscow ELEKTROTEKHNIKA in Russian No 3, Mar 80 pp 48-50 manuscript received 6 May 79

BAGINSKIY, B. A., and OTRUBYANNIKOV, YU. A., candidates in technical sciences

[Abstract] Thyristor-type pulse shapers are widely used in industry, but no systematic engineering design procedure has yet been developed for them. Here such a pulse shaper is considered which includes a transformer in the output stage, with a polarized capacitor in series with the primary winding and a diode in series with the load resistance on the secondary side. In the case of a d.c. supply, the thyristors can be turned on and off either by changes in their d.c. current or by forced commutation. The analysis is simplified by assuming a lossless capacitor and a transformer with zero leakage flux. On this basis, expressions are derived for the capacitor

discharge voltage and current as functions of time, in the aperiodic (over-damped) mode and in the oscillatory (underdamped) mode, for the pulse duration and the pulse repetition rate, as well as for the discharge-circuit utilization factor characterizing the energy relations. According to these expressions and with the aid of graphs the circuit parameters are calculated, including the series charge resistor, for given requirements. Because of criticality with respect to the pulse repetition rate, this design procedure involves trial-and-error iterations. Figures 3; references: 3 Russian. [205-2415]

ELECTRICAL ENGINEERING EQUIPMENT AND MACHINERY; APPLICATIONS AND THEORY

UDC 537.266:621.315.616.9

CONSTRUCTION, PROCESSING AND ANALYSIS OF TEMPERATURE-FREQUENCY RELATIONSHIPS
IN HIGH FREQUENCY DIELECTRIC LOSSES

Moscow ELEKTRICHESTVO in Russian No 3, 1980 pp 56-59 manuscript received
28 Aug 79

KHRENKOV, N. N. and CHERNYSHOV, S. K., Mytishchi

[Abstract] Modern technology tends to expand the range of working frequencies to the tens of gigahertz at working temperatures under -150°C. Nonpolar polymers--low density polyethylene and polytetrafluoroethylene are used for many high frequency articles. The concentration and generalization of data have a substantial value for planning electro-technical items. For concentration of experimental data on dielectric losses, temperature-frequency diagrams (or reliefs) should be used and supplemented by Arrhenius curves. Regions of abnormal absorption can be detected. Information concentrated in the reliefs may be presented as two-dimensional matrices, written on computer media and processed in automated planning systems. Figures 4; references 14: 8 Russian, 6 Western.

[183-8617]

UDC 621.3.085.2

ON THE ACCURACY OF AN A.C. STABILIZER EMPLOYING THE INDUCTION SUSPENSION PRINCIPLE

Moscow ELEKTRICHESTVO in Russian No 3, 1980 pp 61-64 manuscript received 24 Apr 79

BUL', B. K., doctor in technical sciences, ABDULLAYEV, YA. R., candidate in technical sciences and REZTSOV, V. N., engineer, Moscow Power Engineering Institute

[Abstract] Current stabilizers using the principle of induction suspension may be constructed in two versions: with moving secondary or moving primary. Structurally a current stabilizer consists of a vertical E-shaped magnetic circuit and a moving armature. The field between parallel rods of the elongated E-shaped magnetic circuits is almost uniform. Field distortion is only observed near the excitation winding and armature air gap. Accuracy of stabilization ranges from -1 to +0.77 percent. Supply voltage frequency has little effect on stabilization accuracy. The stabilizing properties of the stabilizer deteriorate if a load resistor is connected to the screen circuit. Change of screen mass affects the nominal values of stabilized currents. Figures 4; references: 4 Russian.

[183-8617]

UDC 621.313-181.4.004.15

MORE EFFICIENT DEVELOPMENT OF SMALL-POWER ELECTRICAL MACHINES BASED ON THE SYSTEM APPROACH

Moscow ELEKTROTEKHNIKA in Russian No 3, Mar 80 pp 5-7 manuscript received 7 Aug 79

PROZOROV, V. A., candidate in technical sciences

[Abstract] A redesign of small-power electrical machines is to be undertaken which will cover the entire gamut of types and sizes in demand, in volumes ranging from a few hundred to a few million items annually. The development process leading to a new standard assortment will be made more efficient by adoption of the system approach. Implementation of this approach is based on "target trees" which identify hierarchically the labor as well as the materials and the tools required for each product component and for the subsequent integration. This approach involves quantitative

evaluation of a new product relative to the one it is to replace, from the standpoint of technological complexity and performance parameters. Such an approach allows for consideration of alternatives and selection of the optimum variant all along on the basis of, among others, functional-cost and quality analysis. Figures 1; references: 6 Russian, [205-2415]

UDC [621.313.333-181.4].001.2

SMALL-POWER LINEAR INDUCTION MOTORS

Moscow ELEKTROTEKHNIKA in Russian No 3, Mar 80 pp 14-17 manuscript received 12 Mar 79

VESELOVSKIY, O. N., candidate in technical sciences

[Abstract] Small-power linear induction motors serve as drives for various production and automation mechanisms. Here the low-speed reciprocating type is considered with characteristics, including noiseless operation, which distinguish it from the large high-speed propulsion type. Small low-speed linear polyphase induction motors are designed for short and intermittent duty, to produce a large thrust force without particular regard for efficiency. They are, accordingly, built either with a large number of pole pairs or with cascading of stages. The longitudinal edge effect is hardly significant here and does not have to be compensated. Their construction is either flat or cylindrical, with the advantages of no transverse edge effect and no coil heads in the latter case. Their performance is usually evaluated by the methods of dimensional analysis and dynamic similarity, according to criteria also applicable to magnetohydrodynamic induction motors. Noiseless operation calls for a high slip, with the synchronous speed not exceeding 3-12 m/s. Small motors of this type, and particularly micropower motors, produced at the Electrical Transportation Plant imeni F. E. Dzerzhinskiy in Kiev contain all these main features. Manufacturability and utilization of materials are optimized, furthermore, by splitting the core laminations, winding the coils toroidally, and stranding the inductor. Low speeds can also be attained by voltage and frequency regulation, rather than by a high slip with attendant high losses in the secondary. It has been possible to reduce the minimum feasible pole pitch from 3 to 1 cm. A typical motor of this size runs at a speed of 0.7 m/s and develops a starting thrust of 280 N, with an inductor weighing 22 kilogram [sic]. Where only a small thrust but a nearly linear force-displacement characteristic are required, it is expedient to use a short nonmagnetic secondary. Figures 5; tables 1; references: 4 Russian, 1 German.

[205-2415]

UDC 621.314.1

TO THE PROBLEM OF MEASUREMENT OF THE ROTATIONAL VELOCITY OF BRUSHLESS DC MOTORS

Leningrad IZV. VUZ: PRIBOROSTROYENIYE in Russian Vol 23 No 2, Feb 80 pp 39-42 manuscript received 22 May 78

ZUBOV, M. A. and SULYAYEV, A. S.

[Abstract] Reversible and nonreversible devices for measurement of the rotational velocity of brushless DC motors are proposed which use pulse-width rotor position sensors (DPR). Expressions are developed for the transfer functions of the devices. The devices produce an output pulse-width signal, the duration of which is proportional to the rotational velocity. Such a signal can be used without an additional transformation in the pulse servo-systems and drives. Use of the pulse velocity sensors considered make it possible to give up separate electromechanical tacho-generators and thereby to improve the mass-dimension and reliability indices of systems which have brushless DC motors with position modulation. The paper was recommended by the Department (Kafedra) of Automatic Drive, Ryazan' Radio Engineering Institute. Figures 3; references: 6 Russian.

[193-6415]

ELECTROMAGNETIC WAVE PROPAGATION; ELECTRODYNAMICS

FORECASTING TROPOSPHERIC PROPAGATION

Moscow RADIO in Russian No 2, Feb 80 pp 15-17

BUBENNIKOV, S., Master of Sport of the USSR

[Abstract] In the majority of cases tropospheric VHF propagation is caused by refraction of the radio beam towards the earth; under certain weather conditions, waveguide type propagation is possible over a distance which is many times greater than the line of sight. A previous issue of RADIO [No 1, 1976, p 12] treated waveguide propagation; this article covers meteorological factors influencing long range tropospheric scatter and refraction. VHF scatter at tropospheric inhomogeneities is responsible for communications up to 200 to 300 km in the case of a "standard" troposphere. Under favorable conditions, when the scattering coefficient (the ratio of the incident energy at an inhomogeneity to the scattered energy) is high, resulting in positive refraction, tropospheric scatter can permit communication at ranges up to 1,000 km. A fragment of a weather map of the western USSR for days in June, July, August and September of 1979 when excellent VHF tropospheric propagation was noted is used to correlate meteorological factors with periods of good propagation. Long range propagation correlates with solar activity, specifically the 27.3 day solar rotation for an earth observer. The supporting data for the correlations cited was derived from observations between November 1977 and November 1978 in the following regions: Eastern and Central Europe; Southeast Europe and the Eastern European portion of the RFSFR. Correlations between good tropospheric propagation and seasonal weather variations and auroras are briefly noted. Some techniques used by Soviet radio amateurs to determine propagation conditions are also discussed. Figures 2; references: 3 Russian, 1 Western.
[196-8225]

FIELD SCATTERED BY A SMALL SPHEROID IN A CONDUCTING HALF-SPACE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 24 No 12, Dec 79 pp 2431-2439 manuscript received 10 Mar 77; after revision 26 Mar 79

KOCHMANOVA, L. V.

[Abstract] A plane boundary separates air from a conducting medium with negligible displacement currents. A radiating elementary dipole is located at some altitude in air and an ideally conducting spheroid is immersed in the medium below, so deep as to render negligible any perturbation of the primary field due to the source here reflected by the secondary wave at the surface above. The problem of diffraction of electromagnetic waves at such a spheroid is solved for the case of very low frequencies. The spheroid is assumed to be much smaller than the distance from the observation point to the radiation source, its horizontal dimension also being much smaller than the wavelength in air and its vertical dimension being much smaller than the wavelength in the medium below. Both the source and the observation point are located at altitudes above the surface much smaller than the wavelength in free space. The field scattered due to diffraction at the spheroid is calculated from the Maxwell equations in an ellipsoidal system of coordinates. The problem is then extended to a spheroid inside a sphere, with the spheroid varying in shape from the one extreme of a sphere to the other extreme of a thin bar. For a spheroid with semiaxes oy and b , accordingly, the ratio of field intensities I_b/I_{oy} in air has been calculated as a function of the ratio b/oy , with either a vertical electric dipole or a horizontal magnetic dipole as the radiation source. Figures 2; references 8: 2 Russian, 6 Western (one translated).

[204-2415]

LIGHTNING STROKES TO AIRCRAFT

Moscow ELEKTRICHESTVO in Russian No 3, 1980 pp 48-50 manuscript received
27 Sep 79

BAZELYAN, E. M., BRANDENBURGSKIY, V. A., PULAVSKAYA, I. G. and STROGANOV,
B. A., Moscow

[Abstract] Air-borne aircraft are struck by lightning about 30 times more often than similar ground-based objects. Current data, however, do not corroborate pertinent hypotheses, so simulations were carried out in the laboratory. A metal cylindrical electrode 50 centimeters long and 4 centimeters in diameter was used as the model insulated from the ground; it was suspended on fine nylons filaments in a vertical gap in a "rod-plane" field 3 meters long. Charge distribution to the model was determined for various heights of the model above the ground plane. The model attracted the most lightning charges when set on the ground; as the distance between it and the ground was increased, the likelihood of lightning striking the model decreased somewhat. Large aircraft are primarily struck by lightning initiated on their surface. Lightning is evolved by simultaneous development of two leader processes of different polarity from different points on the aircraft. Field strength in the atmosphere required to initiate a lightning discharge on an aircraft decreases in inverse proportion to aircraft dimensions; for an aircraft with a maximum dimension of 50 meters it is about 400 W/cm. Figures 3; references 10: 7 Russian, 3 Western.

[183-8617]

INSTRUMENTS, MEASURING DEVICES AND TESTERS; METHODS OF
MEASURING; GENERAL EXPERIMENTAL TECHNIQUES

UDC 621.317.7.001.4

A DEVICE FOR INSPECTION AND ERROR ANALYSIS OF ANALOG-TO-DIGITAL CONVERTERS

Moscow Pribory i Sistemy Upravleniya in Russian No 3, Mar 80 pp 22-23

SHLYKOV, G. P., candidate in technical sciences, BELOVA, T. L., KUTYRKIN, S. B., REGEDA, V. V., TEMNOGRUDOV, A. V., and SHINDOV, V. S., engineers

[Abstract] At the Penza Polytechnic Institute a statistical error analyzer has been built for inspection of analog-to-digital converters and digital voltmeters which are now being manufactured on a large scale. The analyzer consists of two code-to-voltage converters, a voltage adder, an arithmetic unit, a memory, a control unit and a digital indicator. A bias voltage equal to the nominal voltage of whatever output level is applied to the input of the instrument sample under inspection from an external source of calibrated voltages, through the voltage adder in the analyzer. The integral distribution function and the mathematical expectation of the instrument error are determined with the aid of an auxiliary uniformly distributed noise, the dispersion of the instrument error is determined with the aid of an auxiliary triangularly distributed noise, and the differential distribution function of the instrument error is calculated as the difference between adjacent values of its integral distribution function. The autocorrelation function is determined with the aid of an auxiliary uniformly distributed signal. The algorithm also provides for determining the correlation function at given points, except at point 0 (where it is determined during dispersion measurement). The hysteresis of the instrument error is determined as the difference between its mathematical expectations with an auxiliary sawtooth signal approaching from below and from above, respectively. The results of inspection appear on the digital indicator of the analyzer as well as on external oscilloscope. The analyzer can operate automatically, controlled by a computer. Figures 1; references: 3 Russian.

[206-2415]

UDC 621.317.023

REDUCING THE LOW-FREQUENCY ERROR IN DIGITAL PHASE METERS WITH A CONSTANT MEASUREMENT TIME

Leningrad IZV. VUZ: PRIBOROSTROYENIYE in Russian Vol 23 No 1, Jan 80 pp 3-8 manuscript received 2 Jun 78

SUP'YAN, V. YA. and POKHILYUK, A. P.

[Abstract] Digital phase meters with a constant measurement time have a low-frequency systematic error, inasmuch as the signal period is generally not a multiple of that measurement time. Reducing it by conventional means results in increasing the high-frequency error of quantization and makes the instrument unsuitable for radio-frequency measurements. A digital phase meter with a multichannel time-to-pulse conversion is considered, therefore, which would also keep the high-frequency error small while the low-frequency error is reduced. An analysis of the measurement process and an evaluation of the statistical characteristics indicate that, with the proper algorithm and only with it, the latter error can be made inversely proportional to the number of converter channels squared. The paper was recommended by the Department (Kafedra) of Radio Engineering Devices, Vinnitsa Polytechnic Institute. Figures 4; references: 3 Russian.
[175-2415]

UDC 621.317.39:536.53

A DIGITAL QUARTZ THERMOMETER

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 3, Mar 80 pp 29-31

GOLEMO, V. A., SIDOROV, M. N., engineers, and KOTLYAROV, V. L., candidate in technical sciences

[Abstract] Two variants of a digital quartz thermometer have been developed at the L'vov Polytechnic Institute. Their differential temperature transducer contains two quartz resonators, a heat sensitive one (nominal frequency 5 MHz, slope of the frequency-temperature characteristic 185 Hz/°C) and a thermally stable one, two oscillators and a mixer. A third quartz resonator in the secondary instrument forms the time base. The output frequency of the temperature transducer does not exceed 25 kHz, and data can be transmitted to the secondary instrument over a cable hundreds of meters long. The first variant is built entirely with small-scale integration. Variance

of the slope is normalized by adjusting the state of the time-base counter with the aid of switching elements appropriately to change the measuring time; variance of the frequency is normalized by adjusting the initial state of the readout counter with the aid of switching elements, and frequency drift caused by aging is corrected by addition of pulses from a separate set of two decoders respectively processing tenths and hundredths of a degree centigrade (frequency drift corresponding to a change of temperature not more than 1°C). The second variant is built with small-scale integration of the time-base counter only, but larger-scale integration of the readout counter and the indicator. Variance of both the slope and the frequency is linearly normalized in the time-base counter only, where the frequency drift is also corrected by addition of upcount pulses at a 250 kHz repetition rate. Figures 4; tables 1; references: 3 Russian.
[206-2415]

UDC 621.317.39:536.53

SERIES Sh71 MEASURING TEMPERATURE TRANSDUCERS

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 3, Mar 80 pp 31-32

BELOV, YU. A., ZAVADSKIY, N. N., and SOTNIKOV, A. M., engineers

[Abstract] A series of measuring transducers for converting signals from resistance thermometers to a standard electric signal, either a d.c. current of 0-5 mA or a d.c. voltage of 0-10 V, has been developed at the All-Union Scientific-Research Institute of Electrical Measuring Instruments in Leningrad and is series produced at the Ufa Geophysical Instrument Building Plant. The Sh71 transducer consists of a bridge circuit, an input d.c. amplifier of the modulator-demodulator-modulator configuration with a differential input, and an output d.c. amplifier with direct coupling of stages and a strong negative feedback. For interference suppression, the two amplifiers are galvanically decoupled by a modulator-transformer-demodulator network. The stabilized power supply includes a source of reference voltage. The instrument nonlinearity is caused by nonlinearity of the resistance-temperature characteristic of the thermometer material (copper, platinum), which also depends on the temperature range, and because of nonlinearity of the voltage-resistance characteristic of the bridge circuit. The resulting error can be reduced by making the instrument characteristic hyperbolic in a way which ensures a zero linearity error at three points within the temperature range (both ends and midpoint). This is achieved by means of two feedback loops, one positive and one negative) around the input amplifier and the bridge circuit. The instrument range is from -200 to +650°C, the accuracy class is 0.4, and the response speed is 1 s. The entire Sh71 series includes 96 modifications. Figures 2; references: 1 Russian.

[206-2415]

UDC 621.374

INVESTIGATION OF SCALE INSTABILITY OF A HIGH RESOLUTION MULTICHANNEL TIME ANALYZER

Leningrad IZV. VUZ: PRIBOROSTROYENIYE in Russian Vol 23 No 2, Feb 80 pp 3-7
manuscript received 3 May 79

DEMCHUK, M. I., IVANOV, M. A. and DANILEVICH, V. V., Belorussian State University imeni V. I. Lenin

[Abstract] Three types of instability of the scale of a multichannel time analyzer (MVA) of high resolution can be distinguished: 1) Instability of "zero" or a fixed point of the scale; 2) Instability of the time-code conversion ratio, average with respect to the scale; and 3) Instability of the nonuniformities of a scale. The methodology and results of investigations of the nonuniformities of a scale are presented. Its magnitude can be a function of the instability of the first two types; existence of this instability leads to the fact the registered time distribution $P(\tau)$ differs from distribution $P_0(\tau)$ at the output of an ideal MVA (with an absolutely stable scale) by the presence of multiplicative noise. Instability of the nonuniformities of a scale is shown to carry substantial information concerning the quality of operation and the possibilities of MVA; specifically, with respect to its magnitude it is possible to estimate the minimum necessary signal-to-noise ratio at the input of a MVA, required for detection of the signal over the noise level. Figures 2; references: 3 Russian.
[6415-193]

UDC 681.2.089.6

STABILIZATION OF SHAPE AND DIMENSIONS OF NEEDLE INDICATORS IN ELECTRICAL MEASURING INSTRUMENTS

Leningrad IZV. VUZ: PRIBOROSTROYENIYE in Russian Vol 23 No 1, Jan 80 pp 18-22
manuscript received 23 Nov 78

MISHIN, V. A. and BELYY, D. M.

[Abstract] Needle indicators in electrical measuring instruments are most vulnerable to dimensional and shape instability in service and in storage. Neither mechanical work-in nor thermal aging does always reduce residual stresses enough to eliminate the danger of unstable balance entirely. Vibratory stabilization prior to final locking of the instrument case is

proposed instead, namely by excitation of the needle to mechanical resonance with an electric signal fed to the coil from an audio oscillator. The effectiveness of this method is demonstrated and the process parameters are established on the basis of stress and strain calculations for standard needle indicators such as those in M4205 microammeters, made of round rod and bent into a J -shape with the lower arm mounted through a stiffening pad. The effectiveness of this stabilization method has also been confirmed experimentally. The paper was recommended by the Department (Kafedra) of Aircraft Instrument Building, Ural Polytechnic Institute. Figures 1; references 9: 8 Russian, 1 Western.
[175-2415]

UDC 681.323+681.325.021

REQUIREMENTS WITH REGARD TO THE SYSTEM FUNCTIONS OF MEASURING INSTRUMENTS ACCORDING TO THE I.E.C. STANDARD

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 3, Mar 80 pp 15-19

GORELIKOV, N. I., candidate in technical sciences, DOMARATSKIY, A. N., candidate in technical sciences, DOMARATSKIY, S. N., engineer, POPENKO, N. V., engineer, and SITNIKOV, L. S., doctor in technical sciences

[Abstract] Instruments used in inspection-measurement and control systems must meet certain functional requirements so as to ensure reliable operation of such systems. The first part of the article (which is to be continued in Issue No 5, 1980) discusses those requirements according to the IEC standard which have not yet been adopted in the Soviet Union. They apply essentially to a standard interface with a proper coupling for, and algorithms of, status indication and data transfer in the transmitter-receiver system, with proper formats and codes for compatibility of different components. Information bytes in messages are coded in the 7-bit ISO code, GOST 13052-74 being its USSR analog, and form sequences of six functional parameters fields. The pertinent IEC standard includes norms for input-output parameters of electrical signals with the appropriate voltage limits, means of signal transmission by respectively raising or lowering the potential, load characteristics, time delays, specifications for hardware components, especially cable construction for mechanical reliability as well as cable shielding for electrical interference immunity, mechanical and electrical specifications for contactors and connectors, plugs and sockets. Figures 4; tables 6; references: 3 Russian, 4 Western.
[206-2415]

UDC [681.586.57:621.384.3]:543.81

CONCERNING ONE METHOD OF CONSTRUCTING AN INFRARED HUMIDITY SENSOR

Leningrad IZV. VUZ: PRIBOROSTROYENIYE in Russian Vol 23 No 2, Feb 80 pp 34-38 manuscript received 10 Apr 79

VOLKOV, YE. F., YERSHOV, N. N., SOLNTSEV, V. A. and TIMOSHCHUK, T. S.

[Abstract] A method is proposed for constructing a new type of humidity sensor which makes it possible to obtain high sensitivity to changes of humidity. Existing sensors and the one proposed are compared. The proposed measuring circuit is realized in an infrared sensor of the humidity of paper fabric which is under development at present at the Department (Kafedra) of Automatics and Telemechanics, Leningrad Electrical Engineering Institute imeni Ul'yanov (Lenin). Laboratory tests of the sensor show that with achievement of measuring circuits based on domestic components with $\gamma = 0.8$, the sensitivity of the sensor amounts to 0.5 percent of the absolute humidity. Derivation of the required value of the parameter γ is attained by a change of the transmission factors of the information and reference channels of the optical system of the infrared sensor. The paper was recommended by the Department (Kafedra) of Automatics and Telemechanics, Leningrad Electrical Engineering Institute imeni Ul'yanov (Lenin). Figures 3; references: 3 Russian, 1 Western.

[6415-193]

A PSYCHOMETRIC TESTING DEVICE

Moscow RADIO in Russian No 2, Feb 80 pp 13-14

ROMANYUTA, V. and YUMATOVA, L., Moscow

[Abstract] A testing device designed around the B3-09M pocket calculator uses time interval generator and coincidence gate circuitry to display two place numbers with a duration of about 20 msec and a spacing of 180 msec between them for a test subject. The test subject is to memorize the display numbers and repeat them on the calculator keyboard in the same sequence in which they were displayed. A table of random numbers is used to punch in the test sequence beforehand. The device can generate two place numbers with display times of 10 to 50 msec each and a pause between them ranging from 50 to 500 msec; the power consumption is no more than 5 watts and the weight is about 2 kg. No reworking of the calculator circuitry is required and extra leads from its display are brought out to the supplemental timing and keying circuits. The timing interval generator used K172 series IC. A complete schematic of the device is shown. Figures 3.

[196-8225]

MICROELECTRONICS

UDC 621.382

PASTES FOR INTERLAYER INSULATION IN THICK-FILM MICROCIRCUITS

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 3, Mar 80 pp 39-40

ANDRIANOVA, O. V., BELOUSOV, S. A., FILATOV, V. N., engineers, and SHUTOVA, R. F., candidate in technical sciences

[Abstract] Insulating pastes for thick-film microcircuits have been developed which in their composition include crystallizable glasses (pyro-ceramic cement grades STs-273 and STs-163-14) as the matrix and refractive aluminum oxide (alumina or electrocorundum) as the filler. Specimens of powder thoroughly mixed with an organic binder (cyclohexanol or vacuum-grade oil) were tested in thick-film capacitors for mechanical and electrical characteristics as well as for aging characteristics in terms of resistance to heat treatment and heat cycling. The results indicate the feasibility of producing 50-60 μm thick insulation layers with a specific capacitance of 150 pF/cm^2 , a loss tangent of $30 \cdot 10^{-4}$ at 1 MHz, an electrical resistivity of $10^{13} \Omega \cdot \text{cm}$, and a breakdown voltage above 500 V. The paste will spread less than 50 μm on each side, the insulation layer will withstand heat cycling with 10 min at a peak temperature of 800-850°C, below the crystallization point. Two of these pastes, PP-43 and PP-50, are comparable with the DuPont 9429 paste. Paste PP-1 is suitable for screen printing and paste PP-3 is suitable for contact printing in multilayer microcircuit technology. Figures 2; tables 1; references: 4 Russian, 1 Western.

[206-2415]

OPTOELECTRONICS; QUASI-OPTICAL DEVICES

UDC 535.8

CHOICE OF PARAMETERS OF VOLUME REFLECTION GRATINGS FOR OPTICAL ELEMENTS
WITH PRESET FREQUENCY SELECTIVITY

Leningrad IZV. VUZ: PRIBOROSTROYENIYE in Russian Vol 23 No 2, Feb 80 pp
78-82 manuscript received 28 Feb 78

INDZHIYA, F. I., KRUPITSKIY, E. I., SEROV, O. B. and CHERNOV, B. K.

[Abstract] The paper is concerned with a method of determining the parameters of volume reflection gratings with preset selective properties which are described by the width of the principal maximum of diffraction effectiveness and the level of lateral maximums. An example is presented of the use of this method. For verification of the values obtained for the parameters of the grating, numerical calculations were made of the dependence of the diffraction effectiveness of the grating on the length of the light wave. The calculations were made on a computer by a rigorous method for characteristics waves and by the method of guided waves according to a formula derived in the paper. Agreement of the results of rigorous and approximate calculations with the given parameters of the grating is very good. The method presented can be used during engineering calculations of the parameters of reflection gratings with high selectivity. The paper was recommended by the Department (Kafedra) of Radio Engineering Systems, Leningrad Electrical Engineering Institute of Communications imeni Professor M. A. Bonch-Bruyevich. Figures 2; references : 2 Russian, 1 Western.
[6415-193]

OSCILLATORS, MODULATORS, GENERATORS

UDC 621.372.061.2

STABILITY OF ELECTRICAL CIRCUITS OF RECTANGULAR PULSE GENERATORS

Kiev IZV. VUZ: RADIOTEKNIKA in Russian Vol 23 No 1, 1980 pp 97-99
manuscript received 16 Oct 78

KOZIN, YE. V. and NAROUSHVILI, V. V.

[Abstract] The electrical stability of rectangular pulse generators is determined on the basis of an analysis of the summary sensitivities of the output pulse to changes of circuit parameters. The stability indices of the combined envelope of the output pulse are examined, because deviations of the combined envelope after a change of circuit parameters completely determine the deviation of the envelope and phase of the generated pulse. Equations are given for the summary sensitivities of the combined envelope relative to the capacitances or inductances of the generating bandpass circuit. These summary sensitivities do not depend on a specific circuit design and can be determined with practical accuracy on the basis of the known function of the low-pass filter output pulse. The summary sensitivities are found to decrease as oscillations at the peak of the output pulse and pulse-modulated frequency decrease. Figures 1; references: 5 Russian.

{158-7872}

UDC 621.373.53

INTEGRATED MICROCIRCUIT SQUARE PULSE GENERATOR WITH RECHARGEABLE CAPACITOR

Kiev IZV. VUZ: RADIODELEKTRONIKA in Russian Vol 23 No 1, 1980 pp 54-59
manuscript received 14 Jun 78; after revision 19 Feb 79

YAKOVLEV, V. N., RAKHAL', L. and KHATMINSKIY, V. N.

[Abstract] Single-capacitor square pulse generators, designed on the basis of an RS flip-flop and a timer, and their operating principle are described. The performance of the generators in the self-oscillation mode is explained. The effect of destabilizing factors on generator performance is analyzed and ways of optimizing the parameters of the circuitry in terms of efficiency are indicated. The generators are divided into two groups: one with an integrated RS flip-flop and an RS flip-flop built on two integrated NAND type TTL, and the other with an RS flip-flop built on one operational or differential amplifier, or on two operational amplifiers. Generators of the second group have higher efficiency because they have twice the range of capacitor voltage than the first type. Figures 4; tables 2; references: 2 Russian.

[158-7872]

UDC 621.373.432

EFFECT OF AMPLITUDE- AND FREQUENCY MODULATION ON BANDWIDTH OF HIGH-FREQUENCY PULSE OF DIFFRACTION RADIATION GENERATOR

Kiev IZV. VUZ: RADIODELEKTRONIKA in Russian Vol 23 No 1, 1980 pp 49-53
manuscript received 25 Sep 78; after completion 24 Dec 78

BALAKLITSKIY, I. M. and TSVYK, A. I.

[Abstract] The influence of amplitude- and frequency modulation on the spectrum of an HF pulse from a diffraction radiation generator is investigated for the purpose of analyzing the influence of parasitic modulation caused by technical and physical processes that take place in a real instrument, e.g., changes of beam electron velocities in the interaction space, which change the carrier frequency. Relations are derived for analyzing how much influence various factors exert on spectral quality. An analysis of the experimental dependence of the spectral width of a generation pulse and of beam current on residual gas pressure shows that in contrast to a backward-wave tube the spectral quality of the HF signal of a diffraction generator is not influenced very much by a change of residual gas pressure

are a wide range, and that the use of an open high Q-factor resonator substantially reduces parasitic effects that detract from spectral quality. Figures 3; references: 4 Russian.
[158-7872]

UDC 621.373.519.272

THE GSP-3 GENERATOR OF RANDOM PROCESSES

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 3, Mar 80 pp 24-25

KIRIKOV, I. G., AVERBUKH, G. YU. and LEVIN, V. A., engineers; FEDOSEYEV, A. M., candidate in technical sciences

[Abstract] A test signal for statistical analyzers or correlation meters should be a random or pseudorandom one. A generator of random processes has been developed jointly by the All-Union Scientific Research and Design Institute of Scientific Instruments (VNIInauchPRIBOR) in Leningrad and the Leningrad Institute of Electrical Engineering (LETI) and is now series manufactured at the L'vov Biophysical Instruments Plant. The generator operates on the principle of filtering binary noise with a binary sliding-summation filter. It includes a generator of rectangular clock pulses with discrete regulation of the repetition rate over the 0.1-10⁶ Hz range. These pulses trigger a generator of binary noise which consists of a pseudorandom-process generator and a random-process generator. The former is a 25-digit shift register with feedback and produces a pseudorandom M-sequence. The latter contains a physical source of noise which in a random manner interrupts this pseudorandom M-sequence during each of the 200 synchronization cycles. There are also four digital-to-analog converters which form a stepped electric signal with prescribed properties from the random or pseudorandom numerical sequence. Two output amplifiers respectively set the mathematical expectation and the standard deviation of the output signal. This GSP-3 generator has two outputs for the possibility of simultaneously forming two signals with any of a given set of correlation functions or spectral density function. There is an output of binary noise constituting a signal with random or pseudorandom instants of levels "0" and "1" in a TTL circuit. Figures 1; tables 1; references: 4 Russian.
[206-2415]

DESTABILIZATION OF SELF-OSCILLATORS BY NOISE IN COUPLING ELEMENTS

Moscow RADIOTEKNIKA I ELEKTRONIKA in Russian Vol 24 No 12, Dec 79 pp 2488-2496 manuscript received 15 Jul 77

ZACHEPITSKAYA, L. P., KLIBANOVA, I. M. and POYEMSHIN, G. A.

[Abstract] Self-oscillatory systems with many degrees of freedom and with self- or mutual synchronization have in recent years attracted much attention. This study deals with the effect which noise caused by natural fluctuations and parametric instability transmitted through the coupling channels has on the stability of oscillations in such systems. Specifically, a system on N interconnected Thomson generators operating in a steady single-frequency mode with strong synchronization is chosen for the analysis. Its fluctuation spectrum is calculated from the fundamental equation of motion, assuming only frequency fluctuations for simplicity and assuming the fluctuations in any one generator caused by noise in each channel connecting it to the other generators to be respectively uncorrelated. Estimates of the fluctuation level at zero and low frequencies indicate that the effect of noise in the coupling channels increases with the number of generators. The maximum suppression L of low-frequency frequency fluctuations caused by synchronous interaction between generators with a relative spectral noise power density ϵ in each coupling is $L = \frac{N}{1 + (N-1)\epsilon}$ in a system with each generator connected to each other generator and $L = \frac{N}{1 + 2\epsilon}$ in a system with all generators connected into a chain or a ring, $\epsilon = 0$ corresponding to a noiseless coupling channel. Optimum synchronous interaction can, furthermore, be realized only at certain definite values of coupling coefficients, frequency mismatches, and delay angles. Figures 5; references: 5 Russian.

[204-2415]

POWER SYSTEMS; EFFECT OF VARIOUS ITEMS
ON POWER TRANSMISSION LINES

UDC 621.311.016:352.001.24

ENHANCING DYNAMIC STABILITY OF ENERGY SYSTEMS USING RESISTORS IN TRANSFORMER
NEUTRAL LINES

Moscow ELEKTRICHESTVO in Russian No 3, 1980 pp 6-11 manuscript received
29 Aug 78

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[Abstract] A combination of energy systems produces great monetary savings by reducing total system reserve, using plants with maximum parameters and concentrating energy production. But the concentration of significant generating capacity in a limited area produces specific effects which must be considered: an increase in the probability of disruption of dynamic stability of energy supply because of breakdowns in high-voltage equipment. Concentration of electrical power production produces an increase in short-circuit currents; therefore, it is economically advisable to use short-circuit protection devices such as grounding of the neutral lines of power transformers across current-limiting resistors. In most emergencies this is effective, because at least 95 percent of all short-circuits are related to the flow of significant zero-sequence currents. When defining the mathematical expectation of the number of disruptions in stability of a system containing power energy units it is necessary to consider emergencies due to lack of reliability of high voltage equipment. Grounding of the neutral across resistors eliminates delay in reaction and reduces reliance on other stability-enhancing methods. Figures 4; tables 1; references: 4 Russian.
[183-8617]

SELECTION OF CAPACITY OF RESERVE ELECTRIC POWER PLANT OF AN AGRICULTURAL
ENTERPRISE

Moscow ELEKTRICHESTVO in Russian No 3, 1980 pp 1-5 manuscript received
17 Apr 79

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Agriculture Sciences imeni V. I. Lenin], LEVIN, M. S., doctor in technical
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[Abstract] With the modern requirements of electrification and automation
imposed on agricultural production, electrical power supply must be provided
at a more reliable level. Sudden breakdowns in power supply can disorganize
production and damage the national economy, especially on large farms and
complexes where this may involve both production technology and physiologi-
cal and biological processes in animals. A power grid reserve is widely
used abroad to provide emergency during brown-outs or black-outs, but this
policy is not yet followed in our country. This seems to be caused by the
lack of adequate methods for selecting the capacity of such power plants,
thereby complicating the objective evaluation of their economic effects.
There are many criteria involved in selecting power plant capacity: expendi-
ture of material resources, social consequences, e.g., psychological damage
to participants in the production process. An algorithm is developed for
calculating the capacity of reserve electric power plants using a zoning
method to ascertain an optimum distribution of power availability. Figures
1; tables 3; references: 12 Russian.
[183-8617]

PRODUCTION TECHNOLOGY

UDC 621.313.13-181.4.002.2

EFFECT OF THE MANUFACTURING TECHNOLOGY ON THE STARTING TORQUE OF CONTROLLED MICROMOTORS AND MOTOR-GENERATORS

Moscow ELEKTROTEKHNIKA in Russian No 3, Mar 80 pp 17-19 manuscript received 26 Apr 79

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[Abstract] A determination is made of the effect which manufacturing variances of functional parameters, within their tolerance limits, have on the starting torque of controlled squirrel-cage micromotors and motor-generators for use in aircraft automation systems. The dependence of the starting torque on the influencing design and service parameters is, accordingly, expressed in the form of an analytical relation. The information sought can be obtained either by differentiation or by direct calculation for discrete values of each variable. The results obtained by the latter method reveal that the dominant factors affecting the starting torque of controlled micrometers and motor-generators are the number of conductors in the squirrel cage, their width and depth, and the electrical conductivity of their material. The starting torque is relatively little affected by variations in the conductor length, in the rotor diameter, and in the stator bore. A further analysis of the results indicates that the most expedient way to increase the starting torque and to decrease its variance is: to narrow down the tolerance on the width and the depth of rotor slots, to improve the precision of rotor machining and assembly operations, to ensure continuity of rotor bars in the manufacturing process, and to seek a material for rotor conductors which has not only a high electrical conductivity but also a low thermal expansivity. The overall tolerance field must be calculated also taking into account the allowable variance of the starting torque. Figures 3; tables 1.
[205-2415]

RADARS, RADIO NAVIGATION AIDS, DIRECTION FINDING, GYROS

UDC 621.3.085.2(088.8)

THREE-PHASE RESONANCE TYPE SUPPORT WITH ELECTRICAL CONNECTION

Leningrad IZV. VUZ: PRIBOROSTROYENIYE in Russian Vol 23 No 2, Feb 80 pp 63-67 manuscript received 24 Mar 79

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[Abstract] Development of highly sensitive devices for navigation systems involves the application of magnetic-type supports. Of the low-power supports of this kind used in float-type devices, those with a resonance electrical circuit are most widely found. Past investigations have shown that with a magnetic-type support it is possible when there is noncontact suspension of the sensitive element to impart to the element a rotation necessary for some types of navigation devices. It is shown that such a rotation can be produced by the introduction of an electrical connection into the circuit of a three-phase resonance-type support. The manner in which this is done is explained. A new feature in the support is found--its rotation in a centered position. The equation of motion of the support rotor is obtained. It is possible to use such a design, which assures simultaneous suspension and rotation, during development of gyroscopic devices and other automation units. Figures 2; references: 4 Russian.

[6415 193]

SEMICONDUCTORS AND DIELECTRICS; CRYSTALS IN GENERAL

UDC 621.315.592.012.6.001.24

A WAY OF EVALUATING THE DYNAMIC CHARACTERISTICS OF THYRISTORS FOR DIFFERENT LOADS

Moscow ELEKTRICHESTVO in Russian No 3, 1980 pp 64-67 manuscript received 20 Apr 79

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[Abstract] A quantitative method of evaluation of the dynamic characteristics of thyristors is considered based on synthesis of actual transient characteristics under active load. The operative method is used where the device may be seen as a dynamic link to whose input is applied a voltage and from whose output is tapped a current. With series connection of a resistor with the inductance coil or capacitor, the transmission function of the load represents the sum of transmission functions corresponding to the active and inductive or active and capacitive loads. Oscillograms were recorded for currents and voltages characterizing connection of VKD-20 thyristors. For active inductive loads, discrepancies between the measured and theoretical values were small. For active capacitive loads the discrepancies occur at the end of the transient process because the inductive nature of the pnpn-structure decreases because of a reduction in current gain in the presence of increased current density. Figures 4; references: 4 Russian, 1 Western.

[183-8617]

SYSTEMS ANALYSIS

UDC 621.37/39(047)

APPLICATION OF MICROPROCESSORS IN ELECTRONIC SYSTEMS AND CONTENT OF TRAINING MATERIALS FOR RADIO ENGINEERS

Kiev IZV. VUZ: RADIODELEKTRONIKA in Russian Vol 23 No 1, 1980 pp 100-104
manuscript received 10 May 79

GRISHIN, YU. P., KAZARINOV, YU. M., KATIKOV, V. M. and NOMOKONOV, V. N.

[Abstract] Various aspects and problems of the design of signal processing systems that incorporate microprocessor assemblies for the development of microsignal processor systems with an efficient interface between the microprocessor and computer, are examined. The authors point to a need for a careful re-examination of possible algorithms for solving processing problems, including ones thought heretofore to be unfeasible, in consideration of new opportunities afforded by various large integrated circuits. Software and hardware operations must be intelligently combined in order to reduce requirements on the computing capability of microprocessors and to simplify microprocessor design. Recommendations are offered on how to improve an initial design of a microsignal processing system on the basis of analysis of the hardware and software costs of the original version. Deficiencies in present practice of teaching radio engineers are mentioned, and it is recommended that the special course "Application of Microprocessors in Electronic Systems" be adopted, because its content combines new knowledge with the content of previous courses, which should be updated. There is an urgent need to prepare new textbooks that present not only the features of the radio engineering application of microprocessors, but also basic radio engineering training and a model of "conceptualization" for the electronics engineer. Figures 1; references: 8 Russian, 1 Western.
[158-7872]

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